



Hydrogen Production

Now and Then, and Then Some

Strategic Goals

The use of hydrogen as a fuel and energy carrier can provide options toward achieving our national strategic goals

- Energy security
- Environmental security
- International competitiveness

Technology Development Goals

Hydrogen production projects

- Improve efficiency and lower the cost of fossil-based and biomass-based hydrogen production processes
- Advance emission-free and renewable-based hydrogen production technologies toward commercial viability

Fossil-Based Production Processes

In addition to ITM and SER mentioned by Sig

- Thermal dissociation of methane using concentrated solar power
- Thermocatalytic production without CO₂ emissions
- Plus a number of other exciting projects that will be presented Tuesday afternoon and Wednesday morning in Group A

Thermal Dissociation of Methane

Using a Solar-Coupled Aerosol Flow Reactor

- University of Colorado at Boulder and NREL
- Use of the High Flux Solar Furnace with concentrations up to 2000 suns
- Preliminary results indicate extremely high conversion efficiencies
- Excellent teaching tool (2 Senior Design project teams and a number of graduate students)

Thermocatalytic Production

CO₂-free from Fossil Fuels

- Florida Solar Energy Center
- One-step thermocatalytic decomposition of hydrocarbons in the absence of air and/or water
- Produces hydrogen and solid carbon, no CO or CO₂
- Fuel flexible - investigating methane, propane, and liquid hydrocarbons

Electrolytic Hydrogen Production

- High efficiency steam electrolysis
- PEM electrolysis
- Electrolytic refueling appliance (Sig showed photo)
- Projects will be presented on Thursday morning

Biomass-Based Hydrogen Production

- Biomass pyrolysis for hydrogen production
- Integrated hydrogen production from agricultural residues for urban transportation
- Supercritical water gasification with partial oxidation
- Hydrogen production from renewable organic waste
- Projects will be presented on Wednesday morning in Group A

Integrated Production

Agricultural residues for hydrogen production
with co-product carbon

- Clark Atlanta University and Scientific Carbons
- Improvements to existing activated carbon process using peanut shells in a pyrolysis reactor
- Pyrolysis vapors can be processed to produce hydrogen for use in urban bus fleet
- Other valuable co-products are also possible, and fit well with the local industrial makeup

Photolytic Production of Hydrogen

Biological and Electrochemical Approaches

- Bacterial water-gas shift
- Algal hydrogen production
- Photoproduction of hydrogen from glucose
- Photoelectrochemical hydrogen production
- Photocatalytic hydrogen production using a dual bed system
- Projects will be presented Wednesday morning and afternoon in Group A

Algal Hydrogen Production

2-phase system making lots of hydrogen

- NREL, ORNL, University of CA Berkeley
- Innovative system discovered in FY1999
- Temporal separation of hydrogen and oxygen production
- Deprive the algae of sulfur, and they will do anything - even produce hydrogen
- Highly successful team effort that has attracted significant interest in the general and scientific press

Hydrogen Production

Now and Then, and Then Some

- 27 projects will be critically reviewed
- Near-term fossil-based and electrolytic processes can provide hydrogen for end-use applications at competitive prices
- Mid-term biomass- and improved fossil-based processes have excellent economic potential, AND can contribute to reductions in greenhouse gases
- Long-term renewable-based systems will provide water-based production systems with no emissions